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June - November 2025

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Publication Date  
1 November 2025

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# Seeing the Truth in Honey: How Light Helps Detect Fake Kelulut Honey

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## The Science Behind the Shine

Kelulut honey, produced by stingless bees, has become one of Malaysia's most cherished natural treasures. Its sharp sweetness, healing qualities, and golden glow make it both a gift from nature and a source of livelihood for local beekeepers. Yet, as demand for this precious honey grows, so does the temptation to cheat. Somewhere between the hive and the bottle, some sellers quietly mix in sugar syrup, rice syrup, or water. What seems like a harmless shortcut ends up weakening the purity of the honey and the trust that binds consumers to honest farmers.


For years, scientists have searched for reliable ways to spot such deceptions. Traditional tests that rely on taste or colour often fail to reveal the truth. Even chemical analyses, though precise, can be costly and slow. But a new idea is now emerging, one that relies on something both simple and universal: light.

Every liquid bends light in its own way, a property known as the refractive index. Pure Kelulut honey has a distinctive refractive index created by its unique blend of natural sugars, moisture, and minerals. When other ingredients are added, this delicate balance changes, and so does the way light moves through it.

In 2018, researchers found that a simple laser beam and an optical sensor could detect these subtle changes. When the laser passed through pure honey, the light behaved predictably. But when the honey was mixed with syrup or water, the intensity of light that reached the sensor shifted, revealing the hidden tampering. It was a small but brilliant discovery that offered a faster and more affordable way to identify fake honey without using any chemicals.

A more recent study took this further. Using a Tunable Laser Source, which allows light to change colour, scientists tested samples of stingless bee honey mixed with different amounts of glucose syrup. The results were clear. As more syrup was added, the light that passed through became stronger. This showed that the purity of Kelulut honey can be determined by observing how light interacts with it. It is a clean, non-destructive, and environmentally friendly method that lets science speak for nature.

In 2024, another group of researchers explored how adulteration affects honey's physical properties such as thickness, moisture, and refractive index. Their findings confirmed a consistent pattern. The more foreign syrup added, the denser and optically heavier the honey became. Each drop told its own story under the glow of the light.



## Why It Matters

These discoveries reveal that light, something so natural and ever-present, can become a trusted guardian of authenticity. The refractive index of honey works like an invisible fingerprint that records its purity. If this fingerprint can be read quickly and accurately, it could transform how honey is verified at farms, markets, and collection centres.

For small Kelulut beekeepers, this breakthrough could mean fewer losses and greater confidence in their product. For consumers, it means reassurance that what they are buying truly comes from the hive and not from a mixture made in a kitchen. It is science serving honesty, and honesty protecting tradition.

## Looking Ahead

Researchers are now working to create portable devices powered by simple batteries that combine sensors, microcontrollers, and small power units. These tools could make testing honey as easy as checking temperature or acidity. Imagine holding a small device that can tell, within seconds, whether the honey before you is pure or mixed.

The concept remains simple but profound. When light meets honey, truth emerges. In that shining moment, Malaysia's Kelulut honey stands proud as a symbol of purity, trust, and innovation.

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**Biznewz 2025**  
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